Upgrading traditional technologies in small-scale industrial clusters: producer-driven innovation adoption in Indonesia

Sandee, Henry; Rietveld, Piet

1997

Faculteit der Economische Wetenschappen en Econometrie

3

Serie Research Memoranda

Upgrading Traditional Technologies in Small-Scale Industrial Clusters

Producer-Driven Innovation Adoption in Indonesia

Henry Sandee
Piet Rietveld

Research Memorandum 1997-32

vrije Universiteit amsterdam

Upgrading Traditional Technologies in Small-Scale Industrial Clusters

Producer-Driven Innovation Adoption in Indonesia

Henry Sandee
Piet Rietveld

Research Memorandum 1997 ▪ 32

Upgrading Traditional Technologies in Small-scale Industry Clusters
Producer-driven Innovation Adoption in Indonesia

Henry Sandee
Piet Rietveld
Vrije Universiteit Amsterdam

Abstract

This paper discusses processes of technological change in the tile cluster in the village *Karanggeneng* in Central Java, Indonesia. A growing number of producers in this cluster have switched from traditional kiln to so-called handpress production. We will analyze the processes of innovation adoption of the handpress technology in the cluster. Adoption of the handpress technology encompasses certain indivisibilities which require collaboration among producers to render innovation adoption profitable. We will discuss how pioneer adopters share information and stimulate social learning and adoption on the part of their neighbours, because simultaneous adoption of the handpress technology by groups of producers is needed in order to tackle the indivisibilities which pioneers are facing.

Upgrading Traditional Technologies in Small-scale Industry Clusters
Producer-driven Innovation Adoption in Indonesia [1]

Henry Sandee
Piet Rietveld
Vrije Universiteit Amsterdam

1 Introduction

Small-scale manufacturing has long played an important role as a sector where rural workers in Java, Indonesia, could find employment. However, it is increasingly recognized that the position of small-scale industry is threatened by various developments such as competition by large industry and changes in consumer tastes. Changes in income of consumers lead them away from traditional products usually produced by small-scale changes in favour of their larger counterparts. One of the ways in which subsectors of small-scale industry can maintain (or even strengthen) their position is by adoption of innovations leading to the production of new or improved products. The present paper addresses the proces of innovation adoption by small-scale producers who operate in a cluster.

Our study is, on the one hand, motivated by the recent upsurge of interest in clustering as a possible strategy whereby small-scale enterprises can 'stay on board' in the process of industrialization and economic development. It is, on the other hand, motivated by the need to assess innovation in clusters not exclusively in terms of individual choices and opportunities, but to incorporate in the analysis the fact that clusters consist of networks of enterprises which do not only compete but also cooperate. We are interested in appraising the importance of individual versus collective actions by producers in innovation adoption.

In Section 2, we will introduce the concept of clustered industry. Our attention will concentrate on innovation adoption where the producers themselves are the key actors in upgrading traditional technology. Section 3 introduces our baseline ***survey*** in ***the*** tile ***cluster Karanggeneng*** in Central Java, Indonesia. It focuses on the specific characteristics of clustering of traditional enterprise in the tile cluster in the situation prior to technological change. The analysis of ***the*** situation in ***Karanggeneng*** in 1987 provides a background for the analysis of the processes of innovation adoption in subsequent sections. In Section 4, we present the findings of the second survey of our panel of producers in 1990 which shows that innovation adoption cannot be fully understood by focusing on individual adopters only. In Section 5, we discuss the results of another survey carried out in 1990 which covered all

[1] This paper is based on research done in the framework of the PhD study of Henry Sandee on innovation adoption in rural industry (Sandee 1995).

innovators at that stage. This section reveals in more detail the role played by pioneer adopters in stimulating innovation adoption by other producers. In Section 6, we review the findings of the survey among our panel and also the census of all producers, both of which were conducted in 1993. In **Section 7,** the role played by institutional support in innovation adoption is discussed. Finally, conclusions are drawn in Section 8[2].

2. Innovation Adoption in Clustered Small-scale Industry

2.1 Clustering and Innovation Adoption

Clustered small enterprises in developing countries has been receiving renewed attention since the early 1990's. An important reason is the success of clusters of small enterprises in Western Europe, a well known example being Italy. In the Western case, there are examples of clusters where a blend of competition and cooperation has promoted efficiency and innovation. Furthermore, the existence of strong interfirm linkages may contribute to the collective ability to respond flexibly to changes in the structure of demand. Each order may lead to specific interfirm division of tasks, in accordance with the capacities of distinct firms. In this way, there are possibilities for reaching synergies among producers in clusters, something which has recently been referred to as collective efficiency (Van Dijk 1994; Schmitz 1995).

At first glance, the clustering of small-scale industrial enterprises in developing countries does not seem to bring many synergies. In general, these clusters consist of household enterprises which operate independently of other enterprises. Clustering may simply occur when certain bulky resources are available at certain locations only. However, there is also evidence that similar industrial enterprises flock hamlet-wise if markets are extended beyond the direct environment. The proximity of similar enterprises facilitates information sharing, joint purchase of materials, and collective marketing (Weijland 1994). Clustering of enterprise may also be to the advantage of buyers, such as traders and middlemen. There will be considerable transaction costs reductions if they can purchase the products at one location only. Additionally, the cluster context gives buyers an opportunity to choose products of good quality from the range which is offered. Another feature of clusters is that the risks of certain producers not delivering the product are low. Producers know that customers can easily turn to other enterprises when they frequently fail to manufacture output of a certain quality. This reduces the need for the buyers to monitor the manufacturing process (Knorringa 1995).

Innovation is an important strategy for small-scale manufacturing enterprises for strengthening their competitive position. In general, this occurs through upgrading of traditional technology. Such upgrading allows a continuous use of local resources of energy, human resources, and also local

[2] The appendix of this paper summarizes the various surveys that we carried out in the tile cluster *Karanggeneng*.

(demand) markets. It incorporates key elements of traditional technologies, while taking advantage of the higher efficiencies or economies of scale which are inherent to improved technology (Romijn and De Wilde 1991). Innovation adoption frequently leads to transformation of traditional small-scale enterprise. Innovation may make it necessary to concentrate the human resources of the small enterprise on specific production tasks only, instead of their previous allocation over a wide range of jobs; otherwise, the investments may not pay off.

Compared to isolated small enterprises, clusters are in a more favourable position with regard to the adoption of technologies with indivisible elements. Adoption of such technologies requires levels of operation that cannot be operated with profit by individual small enterprises. In this case, adoption may lead to collaboration among pioneer adopters, where producers work **together** to render innovation adoption profitable. The collaboration may concern various stages of the production and marketing chain, such as input collection, marketing and, contrary to traditional production, manufacturing through sharing equipment and workers.

2.2 Producer-driven Innovations

Various actors can play a key role as an initiator of innovations in small-scale industry . We can distinguish producer-driven and trader-driven innovation processes. In addition, innovation may be initiated by other actors such as suppliers of technology and government agencies (Sandee 1995). In the present study, we focus on producer-driven innovations.

Pioneer adoption in producer-driven innovation processes may be initiated by various groups of producers. First, pioneers may be leading traditional producers who are able and willing to take the risks which are associated with innovation. The producers would have best access to markets, information, government assistance, and so on (Smyth 1992; Sverisson 1993). Secondly, the pioneers may also be non-leading producers. They will have a better chance to be forerunners when the risks and uncertainties of adoption are relatively low.

In clusters, there are, in principle, good opportunities for imitating the adoption of pioneers. It may be expected that producers may want to wait until the consequences of adoption by 'neighbours' are visible. There may, however, be a considerable time-lag between adoption of innovations and the observability of impact. In such cases, producers may be stimulated to base their decisions on expected benefits of adoption only. Producers are in the position to periodically reevaluate their attitude towards innovation once more information becomes available as time passes (Burger et al. 1993: Pomp 1994). The possibilities for copying innovation decisions are dependent on the degree of economic inequality in clusters. In the case that small-scale industry clusters consist of enterprises with similar technology there will not be substantial differences among producers with regard to their output batch during a production cycle. Economic inequality in such a situation is related to the number of batches which distinct enterprises can produce during the season or year. Some enterprises may have better access to

resources, labour, or markets than others, which allows them to produce more batches. When traditionally leading producers are pioneer innovators, other producers may not easily imitate adoption, since pioneers are not their 'peers' with whom they easily identity. However, in such a situation, it is of course possible that the pioneers will stimulate innovation adoption by others who are embedded in their network.

3. Traditional Tile Production in 1987 (the Baseline)

3.1 The Market Environment and The Cluster Karanggeneng

Karanggeneng is located on the outskirts of ***Boyolali*** town, which has a population of about 60,000 inhabitants and is the only urban centre in the ***Boyolali*** regency. The tile cluster is situated very close to the main road which links the big cities of Solo and *Semarang* in Central Java. In 1987, tiles from ***Karunggeneng*** were known as the best-quality traditional output from the ***Boyolali*** regency.

Traditionally, in this cluster, tiles are fired in a kiln, which results in better-quality tiles selling at higher prices than in the case of so-called open-fire technology. Compared with open-fire production, the kiln technology is characterized by a stricter division of labour, both within enterprises and also between enterprises and suppliers of inputs and services. Thanks to good transport facilities, the *Karanggeneng* producers have access to a wide market, compared with the other clusters. Transport of tiles is taken care of by the many trucks which operate between the main cities of Java.

Karanggeneng may be ranked among the villages in rice-producing areas near cities which are not industrializing rapidly. Agriculture in the village has diversified and the trend is towards conversion of rice production into more profitable non-rice cash crops, including attempts to introduce vegetable production. Agrarian land and income, are still of great importance for many households. The total population of the village was estimated at 5,200 inhabitants in 1997, while there were some 120 tile producers.

3.2 Tile Production and Marketing Chains

Table 1 and Figure 1 provide an insight into the distinct production-marketing chains through which traditional tiles are marketed. The majority of producers do not sell directly to final consumers. These producers can be divided into three groups. In addition, we will distinguish a fourth group of producers who do sell directly to consumers.

1. Producers who ***sell exclusively to middlemen.*** Their production sites are located on land owned by middlemen, who control a number of clay pits in the village. Purchase and transport of inputs and outputs are in these cases generally taken care of by the middlemen. The latter may not be only intermediaries in tile production; the scope of their economic involvement in the village economy encompas-

ses a range of activities. Alexander (1987) discusses the interlinkage of production, trade, and credit for economic activities in rural Java, and some of her findings are similar to ours. The producers who sell through the middlemen belong to the poorest households in the village, households with no access to land.

2. Producers who ***sell their*** tiles ***to building*** material ***shops*** in towns. These producers work on contract for specific shops, which provide them with regular orders and down payments. The shops collect a number of orders from consumers before they, in turn, place orders with the tile producers. They generally place their orders with a limited number of tile producers who are the local 'trustees', who may contract out part of the work to other producers.

The role of the building material shops differs from that played by the middlemen. The shop owners have no foothold in ***the Karanggeneng*** village economy, unlike the middlemen - who control land as well as other resources. The shop owners pay for part of the orders in advance and it is, in contrast with the middlemen, the responsibility of the producers to purchase inputs. Kinship or family networks play an important role in this production-marketing chain. The trustees who receive orders from the shop owners contract out jobs, especially to producers belonging to their extended family.

3. Producers who ***receive their orders from other producers*** in the cluster. Such outcontracting may take place because the number of orders certain producers accept are exceed their own production capacity. Outcontracting may also arise from certain social pressures, because leading entrepreneurs are surrounded by relatives who may not have sufficient work. It also occurs that certain producers outcontract jobs because in this way they can build up a stock of tiles.

4. Finally, there are producers who ***sell directly to final customers.*** In these cases, the producers will take care of the organization of the transport of tiles to the customer by using the intermediary services of the truck drivers. Customers are generally well informed about where to go for the best tiles in ***Karanggeneng*** considering their budgets. If not, they may turn to the so-called *calo* or *maklar* (intermediaries) for advice. Both receive commissions from the producers for their services.

Figure 1 Traditional Tile Production and Marketing Chains 1987

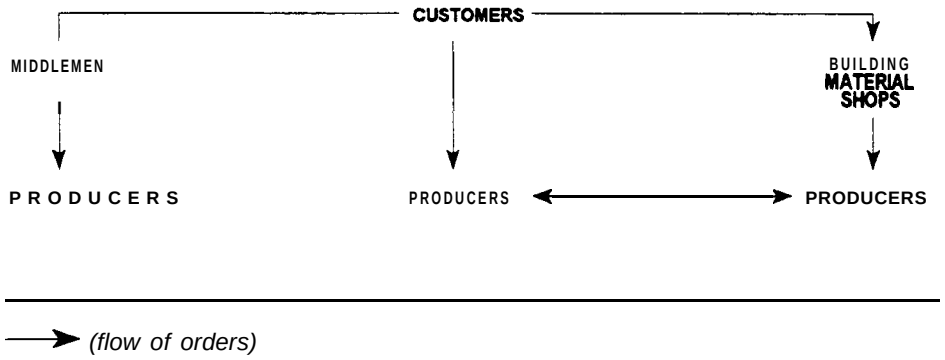


Figure 1. shows the flow of orders in traditional kiln production in the cluster. Producers who do work for the building material shops will contract out orders whenever necessary. It may also happen that producers who sell directly to consumers act likewise, but this occurs much less frequently. Producers who sell to middlemen do not get orders from other sources as well.

Table 1 Comparison of Tile Producers Production and Marketing Chains in Karanggeneng, Dry Season 1987

	Sales to Intermediaries (n=23)	Direct Sales to Customers (n=11)	All Producers (n=34)
Tiles Output (number)	62,400	67,100	63,900
Average Price of Tiles (Rp.)	20.4	29.5	23.3
Family and Household Characteristics	0.13	0.12	0.12
Access to Land (ha.)	572.0	1,204.7	752.9
Seasonal Household Income (Rp.'000)			
Characteristics of the Enterprise			
Industrial Capital (Rp. '000)	264.6	659.7	392.4
Age of Entrepreneur (years)	32.0	47.8	38.8
Ownershin of kiln (%)	70.4	88.1	77.6

Source: own survey

Table 1 presents a comparison of tile producers selling their tiles through different chains. We have made a distinction between, on the one hand, producers who do not have direct access to markets (categories 1, 2 and 3 distinguished above) and, on the other hand, those who sell directly to consumers (category 4). The table shows that the latter not only sell more tiles than the others but also sell tiles at higher prices. This is understandable when we realize that the bargaining position of individual consumers is, of course, not as strong as that of professional middlemen and owners of building material shops. The characteristics of the tile enterprise of category 4 producers show that they have invested more in their business. These producers are also older than the others. Senior producers have been in business for a long time, and this leads to their involvement in the most profitable production-marketing chains.

3.3 Extended Families and Traditional Tile Production

Linkages between producers belonging to the same extended family have, unlike the business and social relations within groups, received little attention in the recent literature on clustering (Rasmussen ***et al.*** 1992; Pedersen ***et al.*** 1994; Schmitz 1995). The same is true for the literature on social learning, which

analyses how producers may master new technologies through observing the behaviour and actions of their neighbours (Case 1992; Pomp 1994). Such family linkages may be especially important in rural industry clusters where the small enterprises are located in specific hamlets in which certain families have been living for generations. Hiisken's study (1988) on rural Java show that insight into the organisation of extended families is an important variable for understanding access to employment and resources.

Clustering of tile enterprise in *Kurunggeneng* allows collaboration in the execution of large construction projects, such as the production of tiles for market shelters. Outcontracting is, in such cases, very **common** among *tile* enterprises in *Karunggeneng.* Middlemen and building material shops are generally involved in commercial subcontracting, where orders are fully contracted out to 'subordinate' firms. Producers with direct access are much more involved in industrial subcontracting. In the latter case, the leading firms remain involved in the production process. They may, for example, regularly check the quality or supervise the firing of tiles made by their ` subordinates'. Industrial outcontracting is likely to be more common among producers belonging to the same extended family or social group. With such large families or groups, trust among producers will be high. Moreover, it may be easy to execute subtle forms of pressure within families or groups, to ensure that subcontractors will perform in accordance with requirements.

In *Kurunggeneng,* family ties are important and most producers can easily point out a number of relatives who are also involved in tile production. Successful producers are expected to share some of their benefits with their less successful relatives. This is also in their interest, because, when needed, it provides 'standby capacity'. As a result, they can accept orders which exceed their own capacity and they can expand their production through the involvement of other producers in their network. There is exchange of workers among extended families, and producers who are temporarily short of labourers may call upon the workers employed by their relatives. Certain producers may even become temporary workers when they are called upon by local leaders who are relatives. Relatives may also be an important source of finance for working capital. Leaders provide advice on quality of output, and they offer apprenticeship to their extended family.

4. Early Diffusion of Handpress Technology

4.1 Introduction

This section discusses the introduction and early adoption of handpress technology in the *Kurunggeneng* cluster When we now look back, we can conclude that the conditions for technological change in *Karunggeneng* were satisfied. It was the most developed traditional tile cluster in the ***Boyolali*** regency, and technological upgrading from traditional to press production could be carried out at relatively low cost, since the press technology resembles to an important extent the traditional tile technology. The market environment for pressed tiles was promising, and producers were aware that

the new product was in great demand. Mechanized tile production contains the same phases in the production process as the traditional technologies. The main difference is that printing is done with presses instead of wooden moulds. Pressing these new tiles requires a better clay mixture, which is obtained through introduction of a diesel-driven clay mixer. Handpress production requires access to mixers which are, at *Rupiah* 2.5 million, too expensive for purchase for pioneer innovators. The mixer is a technological indivisibility; its introduction requires willingness among the producers to collaborate. Joint action is a prerequisite for tackling the new technology with indivisible elements.

Technological change needs actors who take initiatives leading to pioneer adoption by certain entrepreneurs. We have discussed in Section 2 that we may, in principle, distinguish between producer-driven innovation processes and those which are driven by other actors, such as suppliers, intervention agencies, and buyers. In *the case* of *Karanggeneng,* pioneer adoption was initiated by a young entrepreneur from an extended family with long-term involvement in tile production. He is a university drop out who has travelled widely and worked in the big cities of *Semarang* and *Jakarta.* For him, innovation was a challenge which was supported by the extended family. In spite of his age, he was well established as a traditional tile producer. He had visited various pressed tile clusters to learn about the production technology. It took a trip cofinanced by producers, local government and a university to give several *Karanggeneng* producers an opportunity to actually see the handpress technology with their own eyes, and assess *together* whether they were technically and financially able to adopt it as well. The visit convinced the producers that it was possible to introduce this technology in their cluster.

4.2 Differentiation among Tile Producers

Our survey in 1987 included a section in which the producers were asked to look at the future and forecast how their tile business would develop. It is interesting that none of them mentioned that they planned to adopt the handpress technology. Moreover, none of them mentioned that they were considering giving up tile production and moving into other income-generating activities. In reality, however, both developments did take place within a rather short period. Our second survey of the panel group was carried out in the dry season of 1990. Although most producers continued to produce traditional tiles only, there were some who had innovated and there were some who had stopped producing tiles altogether. This section discusses the processes of differentiation among producers in *Karanggeneng.*

Table 2 Developments in the Group of Tile Producers in Karanggeneng, 1987, 1990

	1987		1990			
	Traditional Tiles		Traditional Tiles		Pressed Tiles	
Type of Development	Output ('000)	Price (Rp)	output ('000)	Price (Rp)	output ('000)	Price (Rp)
Production remains traditional (N=25)	67.2	21.7	69.5	35.1	-	-
Partial shift to pressed tiles (N=4)	71.4	26.7	21.6	36.0	57.3	55.0
Production is stopped (N=5)	58.8	25.6	-	-	-	-
All enterprises (N=34)	65.3	23.3	53.7	35.2	6.7	55.0

Source: own survey

Table 2 summarizes the different developments in the cluster. The majority of producers in 1990 were still producing and selling traditional tiles only. Adopters were still also involved in traditional production. The table further shows that there were 5 producers who were no longer manufacturing tiles in 1990. Traditional tile prices rose from *Rupiah 23.3* in 1987 to *Rupiah 35.2* in 1990. This considerable increase is, to an important extent, due to an increase in input prices and also inflation'. The prices of both clay collection and, especially, firewood rose significantly in this period. Moreover, the panel sold fewer traditional tiles, compared with three years previously. Table 2 shows that the decrease in traditional output is explained by the partial shift of some producers to press tiles as well as the exit of some producers from tile production. In the next subsections we will discuss these groups separately.

4.3 Traditional Producers

In 1990, the majority of the producers were still exclusively producing traditional tiles, which were sold through the same production and marketing chains as in 1987[4]. Table 2 showed that they produced

[3] The inflation rate in Indonesia during the period of study was about 10 percent per year

[4] The production sites of those who stopped producing tiles were sooner or later taken over by others. We do not have exact information on the number of tile producers in the cluster in 1990. The number has however definitely declined as a consequence of urban expansion of the city *Boyolali* which has caused resettlement of producers. A new count was carried out in August 1993 of which the results w-ill be reported later in this paper.

slightly more tiles during the dry season, compared with three years earlier. In Table 3, we compare traditional tile producers operating in different chains.

Table 3 Comparison of Traditional Tile Producers Production and Marketing chains in Karanggeneng, Dry Season 1990

	Sales to Intermediaries (n= 19)	Direct Sales to Customers (n=6)	All Producers (n=25)
Tiles Output (number)	67,500	75,800	69,500
Average Price of Tiles (Rp.)	32.5	42.4	35.1

Source: own survey

The table shows that the situation is rather similar to that existing three years earlier. Both groups of producers sell more than in 1987; they produce more batches and use their workforce more hours a day and also more days a season. This growth of output has generally not resulted in an increase in the size of the workforce. The differences between the performance of traditional producers belonging to distinct trade production-marketing chains remain substantial, and producers with direct access to markets sold more traditional tiles and at higher prices than others.

In our survey in 1990, we ask the traditional producers why they had not yet adopted the handpress technology. At the end of 1990, there were 32 adopters in *Karanggeneng,* which meant that there were plenty of opportunities for producers to learn about the advantages of the new technology. A distinction is useful between those who have direct access to markets and others. The first group is selling directly to consumers; manufacturing press tiles would confront them with the problem of marketing new output in a situation in which they are not sure whether there are interested consumers or not. For the second group, those who sell through intermediaries, the constraint on innovation is different. They are, to an important extent, dependent on the decisions of others to innovate. A general reason why there was reluctance to innovate by 1990 relates to the need to invest some *Rupiah* 1 million. At that stage, local banks were very reluctant to finance technological change in *the Karanggeneng* tile cluster. Moreover, the future of the cluster was a topic of discussion at that time, because of the environmental impact of continuous clay digging on the planned expansion of nearby city *Boyolali*.

4.4 Quitting Traditional Tile Production

We saw in Table 2 that a number of producers were no longer involved in tile production in 1990. There are a number of different reasons for their exit. There are cases where abandoning tile production is a sign of downward mobility of the household. Some went bankrupt and left the village;

others became wage workers for other tile producers. There are also examples where quitting tile production is a sign of upward mobility, such as the case where a household was able to get access to a relatively well-paid job in the formal sector. In one of these cases, production sites were actually dismantled. Sites were mostly rented out to others, who could be either newcomers or existing producers, but who were always part of the extended family of those who quitted. Consequently, there were possibilities to return to tile production at a later stage.

4.5 Early Adopters in the Panel Group

Another four producers of the group had adopted the handpress technology by the time of our second survey in 1990. Adopters are underrepresented in our panel group. They were not, as will be discussed below, among the pioneer adopters in *Karanggeneng*. Two of them can be classified as 'typical forerunners' in processes of technological change. They have direct access to markets and resources and possess the necessary skills. Their early adoption confirms the theory that focuses on adoption as a decision-making process by individuals. Here, factors such as education, skills, entrepreneurship, access to resources and capital, and so on, are viewed as crucial factors in the timing of adoption by individual producers (Rogers 1981; Shaw 1987). There are, however, also two adopters who have very different characteristics. They sell their tiles to other producers and they do not have direct access to markets. Furthermore, these producers have rather weak entrepreneurial capabilities, since they have never been exposed to direct trade with buyers. In addition, they are highly dependent financially on leading producers, who provide them with advance payments and who specify the orders.

5. Early Adoption, Networks, and Indivisibilities (Additional Survey among Adopters in 1990)

In this subsection, we report the findings of an additional survey which was carried out in 1990 among all adopters of handpress technology[5]. This survey included the 3 pioneer adopters *in Karanggeneng,* who are defined as producers who adopt without any assistance from local persons or institutions. The pioneers had all joined the trip that gave the producers an opportunity to see and assess the feasibility of the handpress technology. Traditionally, they were leading producers in the cluster; they have direct access to markets and they are frequently contracting out orders to their ' followers'. The first one is a young, ambitious university drop out. Two others are experienced producers who are important persons in their extended families. All three pioneers financed the purchase of the handpress out of their own funds. As mentioned above, an essential (and most expensive) element of the handpress technology is the motorized clay mixer. Since one mixer can be used in combination with about 6 handpresses an indivisibility problem emerges in the first phase of adoption. This was solved by the young entrepreneur who bought the clay mixer after receiving assurance from the other pioneers that they would buy

[5] Thus the additional survey included the four adopters of our panel group discussed above.

presses and use the services of his mixer. So a new network is formed among the pioneers as a necessary condition for producer-driven adoption of new technology with indivisible elements.

Relations among these three pioneers became mutually beneficial: orders for pressed tiles were shared, the mixer was used in turns, and the new output was promoted jointly. The initial lack of interest for technological change in the cluster from traders, middlemen, and building material shops makes it necessary for the pioneers to orientate themselves on the conditions of new markets. However, the pioneers received assistance from manufacturers of press equipment, who spotted new market opportunities. The first presses were bought at relatively low prices and on credit from these suppliers. This facilitated the process of producer-driven technological change. Pioneers also cooperate to create a supportive infrastructure, including credit for worldng capital and repair services, which are necessary due to the lack of support from outside. The strategy of the pioneers is aimed at **minimizing** the risks of the innovation. They are the main actors in the initial stages of technological change. During the early stages of innovation, adopters do not want to lose their access to the market for traditional tiles, because they may need to fully return to production of traditional tiles if the adoption of the handpress technology is not successful. The cluster context offers very good possibilities for adopting and concentrating on press tile production, while keeping access to traditional tile markets through contracting out orders. This points to an advantage which clustered enterprise has over dispersed enterprise. In the latter case, adoption may very soon call for a decision as to whether it is possible to combine traditional with new forms of production. Thus, the fact that it is possible in clusters to outcontract work lowers the barriers of technological change and facilitates adoption (Nadvi and Schmitz 1994; Humphrey 1995).

Figure 2 Traditional Tile and Emerging Press Tile Production and Marketing chains 1988-89

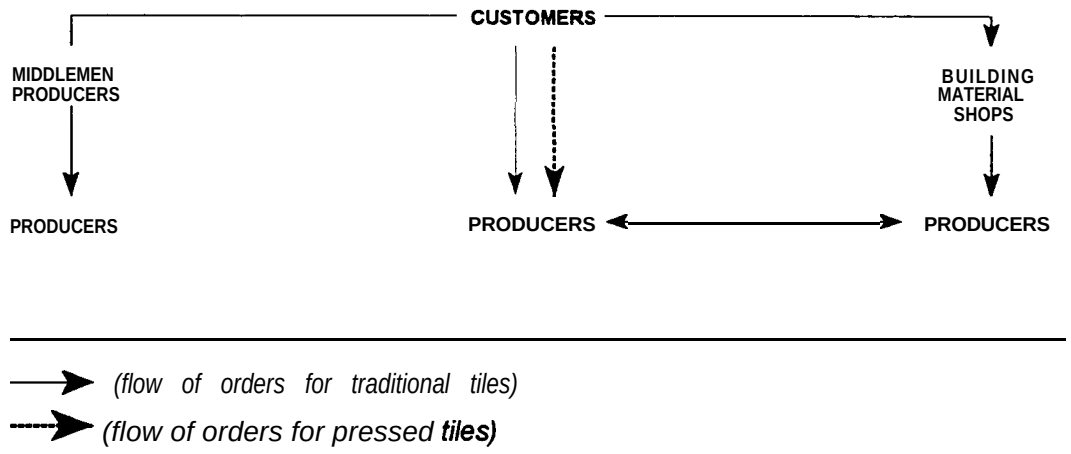


Figure 2 presents an overview of traditional and emerging press tile production and marketing chains in the cluster. At this early stage, pioneer adopters were the only ones involved in press tile production. Subsequent adopters differ from pioneers, since they received technical and/or financial assistance from within the cluster. Their adoption is, in one way or another, related to the pioneer adopters. More importantly, all these subsequent adopters were, especially at the very beginning of their innovation adoption, dependent on the pioneers for the marketing of press tiles. This is an important change compared with the traditional situation, where a substantial number of producers have direct access to markets. We will return to this new market situation below.

By October 1990, there were 32 adopters in the cluster who together controlled 39 presses. An increasing number of adopters decided to stop manufacturing traditional tiles altogether. Although orders for traditional tiles are still accepted, most jobs are contracted out. Table 4 compares characteristics of traditional producers and adopters in 1990[6]. Adopters are younger than traditional producers, and their total household incomes (from tile production and other sources) are higher. The table shows that adoption requires considerable investments.

Table 4 Comparison between Traditional and Press Producers in ***Karanggeneng*** in 1990

	Traditional Producers (N=25)	Adopters (N=32)
Age Entrepreneur (years)	43.1	36.4
Tiles Output (thousands)		
Traditional	69.5	18.4
Press		60.4
Tiles Prices (*Rupiah*)		
Traditional	35.1	36.4
Press		58.2
Industrial Capital (*Rupiah* '000)	264.6	1,350.8
Household Income (*Rupiah* '000)	980.7	1,532.4

Source: own survey

[6] The &ta on traditional producers are from the second survey of the panel, while the data on press producers are from the additional survey of adopters in the cluster.

Slightly more than 50 per cent of the early adopters financed the press out of their own savings or those of their families. Others relied on funds from pioneer adopters (30 per cent), NGOs (10 per cent) and traders (10 per cent).

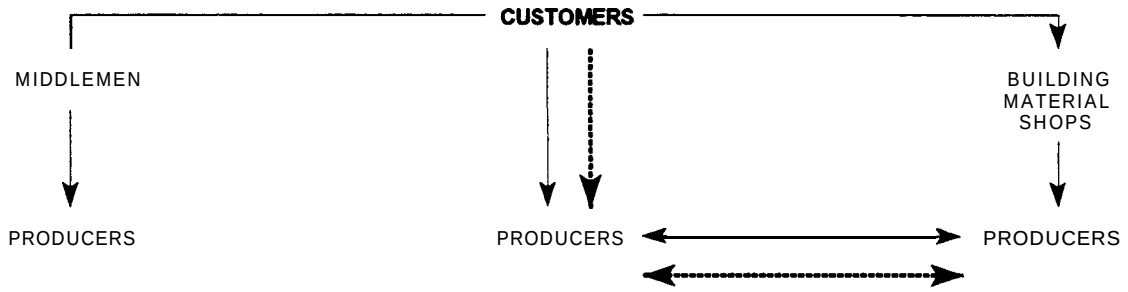
The important role of pioneer adopters becomes clear when we examine how presses are actually bought, how adopters learn to master the new technical skills, how they gain access to mixers, and especially how they market their new output. The majority (80 per cent) of the early adopters did not *buy the press* themselves. They placed their order with one of the pioneers. It is the young pioneer who has ordered large numbers of presses simultaneously, and the adopters pay him and not the suppliers directly. The same group of adopters also relies on this pioneer for learning the *technical skills*. By 1990, there were four *mixers* in *Karanggeneng*. A first one is shared by two pioneers and a group of early adopters. Two mixers are owned by the young pioneer, while another mixer is managed by a non - governmental organization (NGO) which has set up a project in the cluster.

An important development is that the young pioneer is no longer collaborating with other pioneers, but is heading his own network. By 1990, this network was already the largest in the cluster, and it is, in fact, an 'upgrading' of his traditional network discussed above. By 1990, the pioneer had gained access to larger orders, which call for joint production by a number of tile enterprises. One of the reasons for the upgrading of the traditional network is that it has allowed the pioneer to achieve higher profits than would be possible through joint production with other pioneers. Another important reason for upgrading, however, is the emergence of social pressures from the extended family to share the higher benefits of press tile production with relatives.

Finally, and very importantly, early adopters are very dependent on pioneers for marketing tiles. This is also true for the network of adopters which was set up by the NGO. Pioneers have access to markets, and the young pioneer plays the leading role. By 1990, there was still no interest on the part of either middlemen or building material shops in marketing press tiles from *Karanggeneng*. Consequently, the pioneers were obliged to take a lead in the marketing of output and, by 1990, they were responsible for marketing an important percentage of the press tiles from the cluster. We can observe that in this period adopters were only gradually gaining direct access to final consumers themselves.

Figure 3 presents an overview of the traditional and press tile production and marketing chains in 1990. The temporary network among pioneer adopters has already been replaced by new (vertical) linkages between each pioneer and other producers.

Figure 3 **Traditional Tile and Emerging Press Tile Production - Marketing chains 1990**



(flow of orders for traditional tiles)

(flow of orders for pressed tiles)

As *we* have *discussed* above, *pioneers take an active interest in stimulating adoption by others* in the cluster. There are *several* reasons for this. The first reason is associated with the joint use of the mixer. The *services of the mixer* are not provided free of charge. The costs for mixing clay for a regular production cycle were *Rupiah* 9,000. The job is done by specialized workers who are on the pay list of the owners of the mixer. Owners of mixers, among whom is the young pioneer, are highly motivated to stimulate diffusion, because this will increase demand for services of mixers. A second reason is related to the reluctance of traders and others to market pressed tiles from *Karanggeneng* during the period 1987-1990. This implies the emergence of opportunities for local entrepreneurs to *market pressed tile* output. Commissions are charged by pioneers for marketing tiles manufactured by others. A third reason is related to *technical assistance* which is needed to operate the press technology. Such assistance is not required when press equipment is first installed, but there is a need for technical assistance at later stages when the producers want to standardize and improve the quality of output. In *Karanggeneng,* technical assistance in the period around 1990 was almost exclusively provided by the young pioneer and it was linked to the purchase of the press machine. If the press is not bought from the young pioneer, it becomes very difficult to rely on him for technical assistance. Finally, a fourth reason is that the lack of access to funding for the new technology also offers possibilities for local entrepreneurs to engage in new business opportunities. Pioneer adopters, especially the young pioneer, provide *credit* on a large scale to producers who are interested in buying the press technology. They have access to formal credit which they informally lend out to producers who join their network.

6 Further Diffusion of Handpress Technology

6.1 Trends in Traditional and Press Tile Production

The cluster *Karanggeneng* was regularly mentioned in the regional newspapers during the period 1990-1993. Problems regarding the negative environmental impact of tile manufacturing were solved, because the local government allocated new land for clay digging. Urban expansion of *Boyolali* city has resulted in a diversion of heavy traffic which is no longer allowed to pass through the main street of the city. Instead, the traffic passes through the cluster, and this makes the cluster much more accessible to buyers. Both developments have stimulated further adoption of handpress technology by producers. The production of traditional tiles also remains important, however.

We will illustrate the trends in production and prices of press and traditional tiles by summarizing data on our panel group of producers. These panel data need to be interpreted against the background of a declining total population of producers in the cluster. As will be discussed below, the number of tile producers in *Karanggeneng* declined from 123 enterprises in 1987 to 103 enterprises in 1993. Concentration occurred, because producers who stopped making tiles rented out their kilns to others. The average number of kilns operated per firm has therefore increased during the period 1987-1993.

Table 5 Trends in Traditional Tile Production, 1987 - 1993, Data from Panel Group of Producers

	Number of Producers'	Annual Tile Output ('000)	Annual Turnover (Rp.'000)	Average Price (Rp.)	Annual Tile Output perProducer (Rp.'000)
1987	34	2221.5	51,762.3	23.3	65.3
1990	29	1825.7	64,267.8	35.2	62.9
1993	23	1487.8	72.844.6	49.0	64.7

Source: own survey

Tables 5 and 6 present an overview of the developments of prices, production, and turnover of traditional and pressed tiles during the period 1987-1993. Enterprises which manufacture both traditional and press tiles have been treated as follows: their data on traditional tiles are included in Table 5, while those on pressed tiles are reported in Table 6. Table 5 shows tbat there is a decrease in the number of producers in the group involved in traditional tile production. Together, they produce fewer traditional tiles See last colum of table). They sell the tiles at higher prices, however, and so turnover has increased throughout the years'.

[7] The data for 1990 and 1993 include press producers who were still also involved in traditional production.

[8] There were no examples of producers who started traditional production in the period 1987-1993.

Table 6 presents a similar overview for press tile production. Turnover per producer was slightly above that of traditional enterprises. By 1993, there were still 29 producers of the original panel who were still involved in tile production. By that year, therefore, 50 per cent of them had innovated.

Table 6 Trends in Traditional Tile Production, 1987 - 1993, Data from Panel Group of Producers

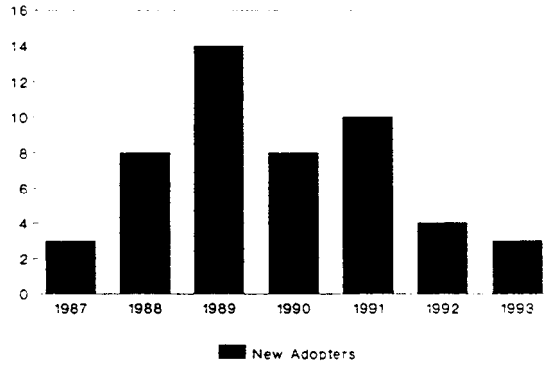
	Number of Producers[9]	*Amlual* TileOutput ('000)	*Annual* Turnover (Rp.'000)	Average Price (Rp.)	Annual Tie Output perProducer (Rp.'000)
1987					
1990	4	229.2	12606.0	55.0	57.3
1993	15	1015.2	69.543.9	68.5	67.7

Source: own survey

The tables indicate that there have been significant price increases for both types of tile. There have been increases in the costs of production due to the higher prices of clay extraction and especially firewood. The increases in the price of firewood have been particularly felt by press tile producers, since they need proportionally more wood for firing than traditional tile producers. Press tiles have to be fired at higher temperatures than traditional tiles. Furthermore, the price increase for traditional tiles are associated with a situation of declining supply and strong demand. This declining supply is a consequence of both the growth of press tile production and the decrease in the total number of producers in the cluster during the period 1987-1993. The price gap between both types of tiles has not changed significantly throughout the years. The substantial increase in press tile output from ***Karanggeneng has*** not had a negative effect on the output prices.

Figure 4 presents an overview of the pattern of innovation adoption in the tile cluster during the peirod 1987-1993. There were 50 adopters by the time of our **final** fieldwork in 1993. The pattern is similar to the often reported bell-shaped function in time (Rogers 1981).

Figure 4 New Adopters of Handpress Technology in ***Karanggeneng*** 1987-1993



[9] The data for 1990 and 1993 include press producers who were still also involved in traditional production.

Figure 4 is useful for roughly distinguishing different groups in the innovation adoption and diffucion process, such as pioneers, other early adopters, majority, and laggards. We see that the annual number of adopters levels off in 1992 and 1993. There were still slightly over 50 percent of the adopters who had not innovated by 1993. This raises the questions of why they have not yet adopted and under what conditions they are likely to adopt in the future.

6.2 Explaining Innovation Adoption

In this subsection, we analyze innovation adoption by means of two data sets. First, we have access to a full census executed in 1993, which covers all traditional and press tile producers[10]. Secondly, we have data derived from monitoring our panel group of producers, which was carried out for the third time in 1993.

We have carried out logit regression analysis with both census data and panel monitoring data to analyze the variables having impact on adoption. The census data merely provide an insight into characteristics of individual producers, enterprises, and their households, while the survey of the group might be more explicit concerning the networks among producers". Table 7 presents the results for the (logit) regression analysis using the census data. The census data allow us to analyze adoption using data on individual producers and their households. Table 7 shows that the education and gender of the producers are the important variables. Education may, for example, indicate the extent to which producers master the national language *bahasa Indonesia*, which is an asset in trade negotiations and also important when producers intend to apply for loans. Gender is another explanatory variable. Up to 1993, there were no female adopters in the cluster, although it is common to find female tile producers - often from female-headed households. We will return to the specific constraints on adoption for female producers further on in this chapter. We see in Table 7 that age of entrepreneur cannot explain adoption by 1993 when almost 50 per cent of the cluster has innovated. It is not, therefore, true that the senior producers who have secured strong positions and production and marketing chains throughout the years adopt earlier than their junior counterparts.

---

[10] This census was part of a research project which specifically aimed at assessing the impact of technological change on female entrepreneurs and workers (Wahjana 1993; 1994).

[11] The census implied conducting brief interviews with all producers by means of structured questionnaires. Such a research method is less suitable as a means of gaining insight into the nature and development of the relations between tile producers. The 1993 survey of our panel focused more specifically on issues of collaboration among firms especially with regard to innovation adoption.

Table 7 **Logit** Regression Analysis for Adoption, Full Model and Selected Variables, Dry Season 1993 (N= 103) Census Data

Variable	Specification 1 Coefficient	(t-value)	Specification 2 Coefficient	(t-value)
Age entrepreneur (years)	-0.01	(-0.14)		
Education (years)	0.6	(2.58)	0.47	**(4.08)**
Access to land (ha)	2.51	(1.10)		
Gender (dummy) [12]	3.01	(2.58)	2.80	(2.54)
Constant	-4.86	(-2.34)	4.70	(-3.93)
Log likelihood	-47.03		47.04	

Source : own field work

We have discussed earlier in this chapter, and also in our theoretical framework, that it may be necessary to complement this individual producer-oriented approach towards innovation in rural industry clusters with an approach which pays attention to the involvement of producers in specific networks. Technological indivisibilities cannot generally be tackled by individual producers. In addition, we mentioned that there are various reasons why certain adopters may want to stimulate further innovation adoption among their colleagues. Our panel group survey allows us to assess the importance of networks while explaining adoption of innovations. In addition, the data make it possible to include, to some extent, trade networks as a variable in the analysis.

[12] If the entrepreneur is female the dummy value is zero, while for male entrepreneurs it is one.

Table 8 **Logit** Regression Analysis for Adoption, Full Model and Selected Variables, Dry Season 1993 (N = 29) Panel Group Data

Variable	Specification 1 Coefficient	(t-value)	Specification 2 Coefficient	(t-value)
Age entrepreneur (years)	-0.05	(- 0.47)		
Education (years)	1.93	(1.84)	1.66	(2.12)
Gender (dummy)[13]	3.01	(0.85)		
Social network (dummy)[14]	4.30	(1.92)	4.35	(2.98)
Middlemen network (dummy)[15]	-3.21	(- 2.45)	-3.42	(- 2.78)
Output 1987	-15.05	(-1.51)	-11.46	(-2.19)
Constant	-0.01	(-1.41)		
Log likelihood	-6.51		-6.62	

Source : own field work

For this purpose, we have also carried out logit regression analysis with the survey data of the panel group. The results are presented in Table 8. Once more the aim is to explain why certain producers adopt while others continue to produce traditional tiles. We could only trace 29 households / enterprises of the original panel group[16]. These data are more specific on the social networks in which the different producers participate. We traced whether producers were relatives of pioneer adopters in the cluster. They are expected to be in a relatively favourable position to innovate, because pioneers may feel obliged to turn first to their relatives when they intend to diffuse the handpress technology in the cluster. We also looked at the relevance of individual characteristics of the producers. In the logit regression analysis presented in Table 8, we also included the variable output level in 1987. The reason is that this variable is representative of the position of tile producers in the cluster at the start of our monitoring research. Successful traditional producers are expected to find it easier to deal with the risks of innovation than others. The regression analysis was carried out first with all variables, and we then continued with selected variables only.

[13] The panel group includes only 3 female producers. They are underrepresented in the panel and consequently gender has no significant impact on innovation in the logit analysis with panel data.

[14] If a producer considered himself / herself to he a relative of a certain pioneer adopter the dummy score was one, while the score was zero otherwise.

[15] When producers sell through middlemen, the dummy score is one, while the score was zero otherwise.

[16] The other households were no longer living in *Karanggeneng*. *They* were reported to have moved to nearby *Boyolali* city and *Semarang*.

The results indicate that education again matters when it comes to adoption. The results confirm the findings of the logit analysis with survey data presented in Table 7. We now see, however, that the social network in which producers operate is also of importance. We noted before that adoption is facilitated if there is a family relationship with a pioneer adopter. This guarantees indirectly access to markets. Such relationships imply that equipment is bought with the assistance of the pioneer. Technical and financial assistance are provided for innovation, orders are received through subcontracting linkages. Table 8 also indicates that producers who sell exclusively to middlemen are in a disadvantageous position with regard to innovation adoption (see also Figure 5). Middlemen link the producers in ***Kurunggeneng*** to rural households, who show little interest in buying press tiles. In the other production and marketing chains, there are better possibilities for participation in press tile networks, especially for those who are relatives of the young pioneer.

With this small number of observations, no significant impact could be found for gender. Interestingly enough, the coefficient for output in 1987 is negative: in this cluster, the introduction of the innovation has led to a rather different distribution of income among producers.

Table 8 points to the importance of interfirm linkages and collaboration for explaining adoption. Adoption is not merely an individual choice of producers which depends on their physical and human resource endowments, their access to finance, and so on. Adoption is also dependent on incentives, pressures, and constraints that producers face in the social network in which they operate. It is, therefore, not only a matter of being able to adopt, but also a matter of whether producers are related to certain pioneers, who are the key agents of change in the cluster (Rasmussen and Sverisson 1994). Ellison and Fudenberg (1992) argue that economic agents, such as tile producers, may base their innovation adoption decision on the experiences of neighbours. They observe their neighbour's choices and the pay offs that these generate. Such observation is indeed facilitated when producers have the opportunity to learn from neighbours (who have adopted) with whom they have much in common, or who, in other words, are their peers. The case of tile production in ***Kurunggeneng suggests*** that additional mechanisms play a role. We found that the social networks in which producers operate are important for explaining innovation adoption. Our findings suggest that producers not only ***learn*** from observing adopters, but may also become ***motivated*** to adopt by their network leaders.

6.3 A Comparison of Traditional and Press Tile Producers

In Section 5, we analyzed the impacts of the innovation adoption based on data sets for 1990. A new network among pioneers was created, but it appears to be only a temporary one. Once the risks and uncertainties of technological change were reduced, there was an upgrading of traditional production and marketing patterns which incorporate the new production technology.

Figure **5 Traditional Tile and Emerging Press Tile Production- Marketing chains 1993**

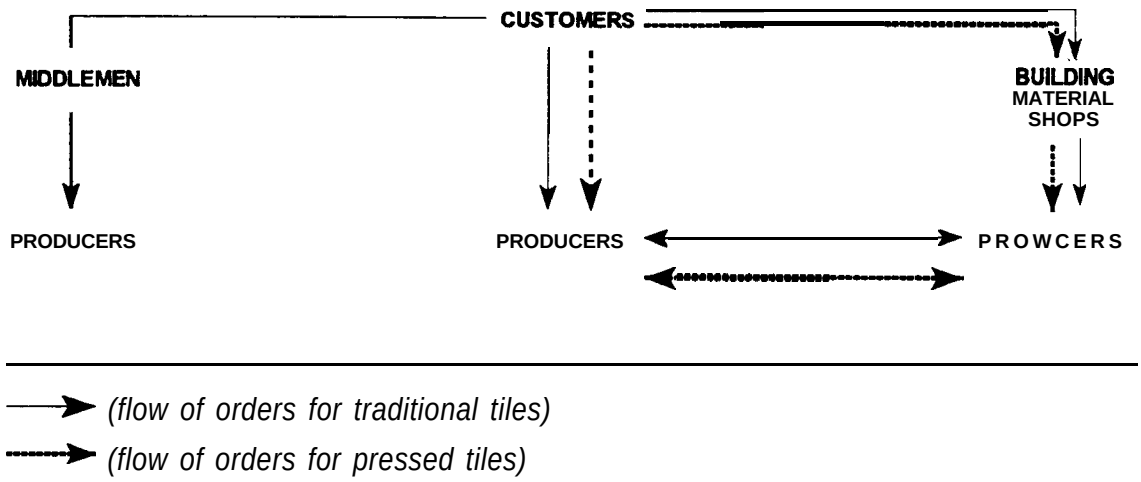


Figure 5 presents a picture of the tile production - marketing chains in the cluster in 1993. We see that throughout the years the flow of orders of pressed tiles has become similar to that of the traditional tiles. Middlemen and building material shops have redeveloped their linkages with producers in *Karanggeneng* to trade the new output. The main difference with the traditional situation is the enormous expansion of the network of the young pioneer, through which a significant percentage of pressed tiles are marketed. In 1993, there were 24 press producers and 5 traditional producers that were dependent on the young pioneer for marketing, technical and financial assistance, and services (including use of the mixer). There are also a number of other networks headed by other pioneers and also by an NGO and a middleman. The scale and scope of these networks does not permit their leaders to provide assistance and services similar to those provided by the young pioneer. For example, if the press machine breaks down, the network has to call on services from outsiders, which increases the costs. It can also be observed that production and marketing chains tend to specialize, with each chain concentrating on a particular type of tile.

Table 9 compares economic characteristics of the traditional and press tile producers in 1993. There were still 53 traditional producers in the cluster, of whom some 45 per cent were females. The table shows that press producers have received more education and that they do not differ substantially from others in terms of age and access to **agricultural** land. There are no female adopters of handpress technology. Adoption of handpress technology leads to an important growth of turnover and an almost

100 per cent increase in the workforce. In Table 9, we make a distinction between male and female traditional producers. The latter have a lower turnover in 1993 and employ slightly fewer (paid and unpaid) workers.

Table 9 Comparison of Traditional and Pressed Tile Producers, Census Data 1993

	Traditional Producers			Press Producers
	Male	Female	All	
	N=29	N=24	N=53	N=49
Average turnover (Rupiah '000)	2,116.20	1,781.90	1,880.90	9,184.30
Age entrepreneur (years)	48.50	44.80	46.80	44.00
Access to land (ha.)	0.06	0.08	0.07	0.06
Education (years)	3.30	2.20	3.00	6.20
Total Paid and Unpaid Employment (persons)	3.40	3.10	3.20	6.00

Source : own survey

Press producers may no longer manufacture traditional tiles, but they are still contacted by a large number of (institutional) customers who want to buy these tiles from them. The jobs, however, are outcontracted, especially to female relatives who have become their subcontractors for traditional tiles. Other producers of traditional tiles are still part of the existing traditional production-marketing chains discussed previously. There are a few cases of traditional producers who have gained direct access to markets as a consequence of technological change by others.

6.4 Constraints on Adoption

We saw in Figure 5 that the number of new adopters started to decrease after 1991. In the years 1992 and 1993, the annual number of new adopters was very small. We noticed in Tables 5 and 6 that the price gap between traditional and pressed tiles has not changed substantially throughout the years. Furthermore, it is likely that costs of production have risen more in the case of press tile production, because it involves the use of larger amounts of clay and firewood per tile. This suggests that press production has lost some of its profitability, but profit per unit of output is still higher for press tile production. Moreover, press tile producers sell more tiles seasonally than traditional producers, which leads to higher absolute profits. So it seems that there are still incentives for innovation for the remaining 53 traditional producers in the cluster.

We saw above that constraints on adoption are particularly felt by female tile producers in *Karanggeneng*. So far, no female entrepreneur has adopted the press technology. Access to networks and dissemination of information on the new production technique is limited to men. Moreover, women

have very limited possibilities for developing their own network, since they have no access to formal credit to finance adoption and cannot rely on money lenders because the latter concentrate on male producers. Women are also much less informed about the characteristics of the new technology, because little information is disseminated to them. More generally, female producers are confronted with norms regarding production and technological change which do not stimulate adoption (Wahjana 1994; Van Velzen 1994). To some extent, therefore, the decline in rate of adoption in the cluster may be due to the reluctance of leaders to include female producers in their networks. In addition, there are also groups of male producers who face constraints on adoption. Some male traditional producers might easily be integrated into the networks of adopters. However, it appears that the leaders of the networks have decided that they have a specific task other than innovation.

Many producers in these groups report that they are interested in innovating but cannot afford it. They lack the means to finance technological change themselves. A number of producers in both groups are already involved in the networks of local leaders, but have the exclusive task of producing traditional tiles. At ***this stage, the Karanggeneng*** cluster remains an important centre for traditional tiles, which limits the possibilities for a substantial number of producers to innovate. A related constraint on further adoption seems to be the strategy employed by leaders in the cluster whereby they give preference to expanding their own firms rather than stimulating further adoption. In principle, there are three possibilities for network leaders for accommodating an increase in demand. They can produce more tiles themselves, they can contract out more to existing adopters, or they can stimulate traditional producers to innovate. Finally, there are also examples of traditional producers who are tied to middlemen who market to specific rural areas where demand for pressed tiles is small.

7. The Role of Institutional Support

Pioneer adoption in ***Karunggeneng*** is an example of a producerdriven innovation process. Early adoption took place without support from local government agencies or NGOs. There was no provision of training, credit, marketing assistance, and so on, to stimulate the introduction of the handpress technology. An important initiative in which the local government participated was the organization of 'study tours' to clusters where the handpress technology was widespread. The tours were important, because they improved access to information, both for producers and also, importantly, for suppliers of capital goods, who saw possibilities for penetrating ***the Karunggeneng*** market.

As we discussed above, around 1990 there was uncertainty as to whether the government would allow the exploitation of new clay pits, and also as to whether the expansion of the city of ***Boyolali*** would not lead to resettlement of tile producers. In more recent years, support increased after the adopters had proved that press tile production was viable. An NGO developed a rotating savings- and credit fund to stimulate further adoption, and also organized technical training. The government has chiefly provided indirect support. It stimulated ***the use*** of press tiles from ***Karunggeneng*** in construction projects in the regency. The local Industrial Office stimulated local government banks to provide loans to potential

adopters. Filly, but very importantly, the urban expansion plans of the city of *Boyolali* were revised and no longer posed a threat to the existence of the tile cluster. Government support has speeded up a process of producer-driven innovation which was already in progress. The support has been effective in improving the press tile producers' access to nearby markets.

The direct support of the government and NGO was characterized by a bias towards male producers. The . study tours' were only accessible for men, in spite of the fact that a substantial percentage of the traditional producers are female. In addition, it is virtually impossible for female producers to gain access to the rotating savings- and credit scheme of the NGO and to formal credit. Thus, government and NGO support have not been able to remove the barriers to innovation by female entrepreneurs. This support may even have reinforced these barriers.

8. Conclusions

Traditionally, tile production in ***the Kurunggeneng*** tile cluster has been dominated by senior producers. They sell large quantities of tiles at high prices. Their good access to markets may lead to a situation in which they receive more orders than they can handle themselves. In this case, there is the possibility for them to contract out work to other producers. Kinship relations may play an important role in these outcontracting networks. The employment situation in traditional production is characterized by a gender division of work according to tasks, in which females are involved in printing which is paid according to the piece-rate system.

Producer-driven innovation processes are the driving force behind technological change in the cluster. Technological, financial, and market gaps were closed through collaboration between pioneer adopters. This, however, is a temporary solution, and soon the new technology package is incorporated into traditional networks, which are subsequently upgraded. As we discussed above, there are several reasons why pioneers have taken an active interest in the promotion of innovation adoption by other producers, since it offers various new business opportunities. Consequently, innovation adoption cannot be viewed in terms of individual choices only. In addition, we need to consider the strategies of pioneers in innovation diffusion who give priority to stimulating adoption by members, including relatives, of their network.

Adoption is explained by both individual characteristics of producers and also the type of social networks in which producers operate. These networks determine their access to markets, technology, and finance. Technological indivisibilities are incorporated into these networks. Senior producers do not adopt earlier than others. Access to the press production and marketing chains is dominated by pioneers and their network. We may conclude that innovation adoption in ***the*** cluster ***Karunggeneng*** leads to a rather different distribution in ***the*** cluster. We observed that ***Kurunggeneng*** has remained an important traditional tile production centre, which hampers further innovation adoption, especially for female

producers. Institutional support has mainly accommodated or speeded up the process of technological change in the cluster through improving the business environment.

Appendix

This chapter is based on *surveys, case studies* and repeated observations *in Karanggeneng in the* period 1987-1993. The various surveys that we carried out in the cluster can be summarised as follows :

a) A *group of randomly selected producers* was interviewed in 1987, 1990 and 1993. When we carried out our first survey among this panel group, the handpress technology had not yet been introduced in *the Karanggeneng* cluster. The surveys of the panel in 1990 and 1993 show that the number of adopters gradually increased.

b) In 1990, we executed another survey among all adopters of the handpress technology at that stage. This survey included some producers who also belong to our panel. They were thus interviewed twice in 1990. The additional survey provided useful information on the processes of collaboration among producers and other actors in the area of innovation adoption.

Table 10 Developments in the Panel of Tile Producers in Karanggeneng

1987	1990	1993	Number of Respondents N=34
Traditional	Traditional	Traditional	15
Traditional	Traditional	Press	8
Traditional	Press	Press	4
Traditional	No tile production	Press	3
Traditional	Traditional	No tile production	2
Traditional	No tile production	No tile production	2

Source: own survey

c). In 1993, we carried out a census ***among all producers*** in the cluster. This census allows a comparison of characteristics of adopters and non-adopters. This census included the producers of our panel, who, consequently, were also surveyed twice in 1993.

The main developments among the members of the group of randomly selected producers during our research period are summarized in Table 10. This table shows diversity in the reactions of similar small-scale tile producers to the introduction of new technology. The table shows the gradual diffusion pattern of the handpress technology throughout the years. The **original** panel consisted of 34 producers. We observe that by 1993 there were 15 producers who continued to manufacture traditional tiles only,

while there are also 15 producers who had innovated. Another 4 producers were no longer making tiles.

References

Burger, K., P. Collier, and J. W. Gunning (1993), . Learning by Observing', Trace Discussion Paper 1993-185, Tinbergen Institute, Amsterdam and Rotterdam.

Case, A. (1992), 'Neighbourhood Influence and Technological Change' , ***Regional Science and Urban*** economics, Vol. 22, No. 2, pp. 55-78.

Ellison, G., and D. Fudenberg (1993), 'Rules of Thumb and Social Learning', ***Journal of Political economy***, Vol, 101, No. 2, pp. 612643.

Humphrey, J., (1995), . Introduction to Special Issue Industrial Organization and Manufacturing Competitiveness in developing Countries', ***World Development,*** Vol. 23, No. 1, pp. 149-162.

Hüsken, F. (1988), ***Een Dorp of Java. Sociale Differentiatie in een Boerengemeenschap, 1850-1980,*** ACASEA UItgeverij , Overveen.

Knorringa, P. (1995), ***Economics of Collaboration in Producer-Trader Relations. Transaction Regimes between Market and Hierarchy in the Agra Footwear Cluster, India,*** PhD Thesis, Vrije Universiteit, Amsterdam.

Nadvi, K., and H. Schmitz (1994), 'Industrial Clusters in Less developed Countries: Review of Experiences and Research Agenda', Discussion Paper No. 339, Institute of Development Studies, University of Sussex.

Pedersen, P.O., A. Sverrisson, and M.P. van Dijk ***(eds.)*** (1994), ***Flexible Specialisation. The Dynamics of Small-scale Industries in the South,*** Intermediate Technology Publications, London.

Pomp, M. (1994), ***Smallholders and Innovation Adoption. Cocoa in Sulawesi, Indonesia,*** PhD Thesis, Vrije Universiteit, Amsterdam.

Rasmussen, J., H. Schmitz, and M.P. van Dijk (1992), ***Flexible Specialisation: A New View on Small Industry?,*** Special ***Issue IDS Bulletin,*** VOL. 23, No. 2.

Rasmussen, J., and A. Sverrisson (19940, 'Flexible Specialisation, technology, and Employment in Zimbabwe', Working Paper 241, technology and Employment Programme, International Labour Office, Geneva.

Rietveld, P., and ***C.*** Gorter (1990), ***'Innovation*** in Small-scale Industry', ***International Journal of Development Planning Literature,*** Vol. 5, No. 1, pp. 1-19.

Rogers, E.M. (1981), ***Diffusion of Innovations, The*** Free Press, New York.

Romijn, H., and T. de Wilde (1991), 'Appropriate Technology for Small Industry: A Review of Issues', Working Papers Series NO. 94, Institute of Social Studies, The Hague.

Sandee, H. (1995), ***Innovation Adoption in Rural Industry. Technological Change in Roof Tile Clusters in Central Java, Indonesia,*** PhD Thesis, Vrije Universiteit, Amsterdam.

Schmitz, H. (1995), 'Collective Efficiency: growth Path for Small-scale Industry', The ***Journal of Development Studies,*** Vol. 31, No. 4, pp. 529-566.

Shaw, G. (1987), 'Approaches to Agricultural Technology Adoption in the Third World: A Critical Review, *Geoforum*, Vol. 18, No. 1, pp. 1-19.

Smyth, I. (1992), 'Collective Efficiency and Selective Benefits: The Growth of the Rattan Industry of Tegalwangi (Indonesia), ZDS *Bulletin,* Vol. 23, No. 2, pp. 51-56.

Sverrisson. A. (1993), 'Innovation as a Collective Enterprise: Case Studies of Carpenters in Nakuru, Kenya', Discussion Paper No. 189, Research Policy Institute, University of Lund.

Van Dijk, M.P. (1994), 'New Competition and Flexible Specialisation in Indonesia and Burkina Faso', in P.O. Pedersen, A. Sverrisson, and M.P. van Dijk (eds), *Flexible Specialisation. The Dynamics of* Small-scale *Industries in* the *South,* Intermediate Technology Publications, London, pp. 55-70.

Van Velzen, A. (1994), *Who is the boss? Marginalisation and Power in Food-processing Household Enterprises, West Java, Indonesia,* PhD Thesis, Universiteit van Amsterdam, Amsterdam.

Wahjana, J. (1993), . Female Participation in Rural Industry. A Case Study on the Impact of Technological Change in Tile Making in Rural Java, Indonesia, MA Thesis, Institute of Social Studies, The Hague.

Wahjana, J. (1994), 'Women and Technological Change in Rural Industry. Tile Making in Java, *Economic* and *Political Weekly,* Vol 29, April 30, pp. 19-33.

Weijland, H. (1994), 'Trade Networks for Flexible Rural Industry', in P.O. Pedersen, A. Sverrisson, and M.P. van Dijk (eds), *Flexible Specialisation. The Dynamics of Small-scale Industries in the South,* Intermediate Technology Publishers, London, pp. 97-l 10.